then goes on to say that "the best storage-battery that has been devised is very wasteful as a source of motive power, yielding at most but forty per cent of the power applied." Now, nothing could be further from the truth than this statement. There is probably not a storage-battery at present on the market that will not yield eighty per cent of the power applied. Almost any person of electrical knowledge and experience knows this to be a fact; and, if further proof be necessary, it will afford me much pleasure to have you send an expert, at my expense, to the electric station of the Julien Electric Traction Company, 85th Street and Madison Avenue, this city, to verify for himself the truth of this statement. He can there see for himself the number of watts the battery receives from the dynamo; and, if the battery does not discharge over eighty per cent of the watts so received, you are welcome to publish the fact to the world.

The next objection the writer raises to the storage-battery system is, that it is "excessively heavy and bulky, making it necessary to carry about three times the load of an ordinary car." Now, "the load of an ordinary car" (16-foot car) is 3 tons: consequently a storage-battery car would have to carry 9 tons of battery, if we are to believe the writer. Now, Car No. 3 of the Julien Electric Traction Company, at present running on Fourth and Madison Avenues in this city, carries just 120 elements, or cells, of battery, each element weighing exactly 27 pounds, or 3,240 pounds; or, with the trays and containing-boxes, 3,600 pounds, — a little over 1¾ tons, instead of 9 tons, as the writer would have us believe. Let me add, in connection with the weight of a storage-battery car, what every engineer knows, that in a locomotive (which the storage-battery car is), to have adhesion, you must have weight.

The 120 cells above referred to contain 52 horse-power hours, and will carry that car over the streets of New York, without being recharged, for a distance of at least thirty-six miles, and carrying over four hundred passengers in all. If the Hauss Electric Railway is now doing equally acceptable and economical work, it would be very interesting for the public to know it. The writer omitted, by the way, to state where the Hauss electric system may be seen, and what practical experience, if any, it has had.

The writer goes on to say that the storage-battery system requires a special car to be built, to provide the necessary space beneath the seats to receive the battery. This is equally untrue. Car No. 3, above referred to, is an old horse-car, and was altered at an expense of about two hundred and fifty dollars for its present purpose. The alteration required is the lifting of the car-body some five inches above its present position.

The next objection the writer has to the storage-battery is, that it "has a life of only two years of constant service, and it is subject to the danger of short-circuiting, which at once destroys its usefulness." The remark as to short-circuiting is very amusing. Am I to understand that the motors constructed by the Hauss Electric Railway (if they do actually construct any) are not subject to the danger of short-circuiting? If so, we must assume that their usefulness is destroyed. Now, we all know that the experience of every electric railway in the country is that the electric-railway motor has the same tendency to short-circuit that the most peevish mule has to kick. If the short-circuited motors of 1888 were made a pile of, we should not need to go to Egypt to see a pyramid. The fact is, that, since the fifteenth day of September last, up to the present moment, we have not short-circuited a battery in our street-car service, although our cars have run in that time in passenger-service some seven thousand miles. This storage-battery short-circuiting is a thing of the past. The cells are at present so connected that short-circuiting is impossible; for the connector would be blown out of position by an excessive current, and thus save the battery. We should be pleased to have you verify this at our station in this city. The writer gives our battery "only two years of constant service." We thank him for that concession, for we only ask six months' constant service in order to compete with the cost of horse-traction. He probably forgets that the material in the battery is not destroyed when the "usefulness" of the battery ends, but is again made over into battery by a process so cheap as to compete favorably with the maintenance of horses.

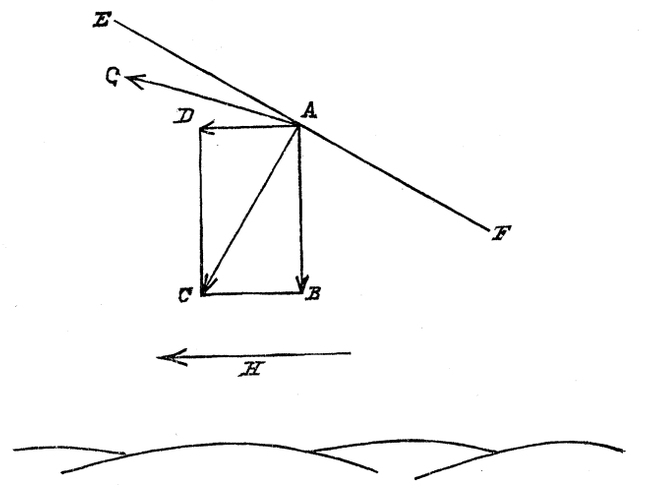
One word more, Mr. Editor, and I have done. Our 18-foot cars, Nos. 1 and 2, now in the service of the Fourth and Madison Avenue lines, in this city, run from 86th Street and Madison Avenue to the Post-Office, and back, — a distance of twelve miles, — on an expenditure of less than fifteen horse-power hours of energy, and frequently carry over two hundred passengers on the round trip. This seems almost too good to be true; but you would do us a favor by inspecting the records at our station, and verifying this statement for yourself. With storage-battery traction there can be no mistaking the amount of energy expended; for we know the number of horse-power hours that are put into the battery, and of course the number of miles such charge will carry the car. Now, for the information of the public, we think it but fair that the Hauss Electric Railway should tell us how far fifteen electrical horse-power hours has carried one of their cars. The comparison would be very interesting.

WM. BRACKEN.

New York, Jan. 5.

The Soaring of Birds.

IN a recent number of *Science* (xii. p. 267) I notice an article under the above heading. It seems to me that we have not yet got to the bottom of the matter, and that the true explanation of the phenomenon is still simpler. Imagine a piece of paper floating in the air. The wind takes it, and carries it along horizontally with its own velocity. After it has assumed the velocity of the wind, there is but one force acting on it; namely, the vertical one due to its own weight. Imagine now a bird under the same circumstances. Instead of travelling with the wind, as everybody who has watched a



soaring bird knows, he travels round and round in circles, each one a little higher than the last, and each one a little farther along in the direction towards which the wind is blowing. Now, when he travels with the wind, he attains nearly its velocity, and then turns and travels against it, rising rapidly at the same time, till he is nearly stationary, or perhaps is even going a little backwards, relatively to the ground. He then turns and travels with the wind again, either moving along horizontally, or perhaps dropping somewhat nearer the earth, until he attains his original velocity, when the cycle is repeated. Comparing his motion with that of the paper, we find that he does not move along so fast: there must, therefore, be some compensating advantage obtained, in order to use up the surplus energy derived from the wind.

In the above figure let H represent the direction of the wind, and A the position of the bird. Let AB represent the force due to his weight, and AD the mean force exerted on him by the wind, owing to the fact that he does not move along as fast as the surrounding air. Combining these, we get the resultant force AC acting upon the bird. Now construct the plane EF perpendicular to the line AC. The bird may then move anywhere in this plane without losing energy. He cannot move to the right of it, but he may move to the left, and thus gain energy. Practically he will move in a spiral about the line AG, thus slowly dropping from the plane

EF, but gaining enough energy by that means to make up for that lost by friction with the air. He will thus gradually rise from the earth, and at the same time drift along with the wind.

WM. H. PICKERING.

Harvard College Observatory, Cambridge, Jan. 1.

The Great Lake Basins of the St. Lawrence.

THE following are the conclusions of a paper under the above title to appear during January in the *Canadian Record of Science*, and the object of which is to suggest what has been the origin of the present contours of the Great Lakes: —

That glaciers, while contributing some results, had not much effect in eroding the lake-basins proper, or in shaping the present general outlines.

That the superficial deposits are the accumulations of denudation during immense periods of time since the carboniferous and earlier eras, and are not to be specially credited to the operation of glaciers.

That Lake Superior is the most ancient of the lakes, dating its origin as far back as Cambrian, Keweenawan, and Huronian times; that it is, in part at least, a synclinal trough; that volcanic action has had most to do with its origin and the shaping of its coasts; that its early outlet was through the depression in Whitefish Bay; and that its waters joined the great pre-glacial river system at or near the Straits of Mackinac.

That Lakes Michigan, Huron, and Ontario were originally the bed of a pre-glacial river which first crossed the Ontario peninsula along the Niagara escarpment, and afterwards was diverted to a course by way of Long Point, Lake Erie, and the Dundas valley; that their basins were largely defined by the elevation of the Niagara and Hudson River escarpments, and in more recent times by warping of the strata and deposit of superficial sands and clays which blocked the old river-channels and resulted in the lake-basins retaining their water on the final elevation of the land to its present general levels.

That the pre-glacial river system expanded into lakes of some size in each of the present basins of Lakes Michigan, Huron, Erie, and Ontario.

That Lakes Erie and St. Clair are the most recent of the lakes, and have at one time been more closely united; and that the formation of this united lake was due to the blocking of the old outlets both by superficial deposits and warping of the strata, and to the water being thus retained in the basin on the final elevation of the land to the levels of to-day.

That great fractures at or near the outcrops of the strata occasioned by the directions of the forces which elevated the strata, originated, in many instances, the deep bays and inlets which indent the Niagara and Hudson River escarpments, and rocky coastlines of Lakes Michigan and Huron; these effects being afterwards supplemented by the action of waves, currents, atmospheric causes, and probably local glaciers.

That since the elevation of the land to the levels of to-day, the action of waves and currents on the clay cliffs and sand deposits has in many places greatly rounded off the general outlines of the coast, and the material from this and other sources has been spread over the lakes, or has served to create new features in the coastline elsewhere.

A. T. DRUMMOND.

Montreal, December, 1888.

Color of Katy-did.

THERE has recently come into the possession of the writer a specimen of the Katy-did showing a remarkable variation in color. The whole body is of a beautiful and delicate rose-pink. The specimen, when captured, did not seem to be abnormal in any other respect. It has been identified by a member of the entomological division of the Agricultural Department as *Phylloptera oblongifolia*. It seems to be a rare variation, though from the same gentleman we learn that at least one similar case has been recorded. A specimen exactly like this one in color is mentioned by Riley in his "Sixth Report on the Insects of Missouri" as having been sent to him many years ago.

L. N. JOHNSON.

Evanston, Ill., Dec. 30.

Various Definitions of Manual Training.

AN article in *Science* of Jan. 4, under the caption of "An Authoritative Definition of Manual Training," embodies an abstract of the report of the special committee on manual training of the New Jersey Council of Education, the semi-annual meeting of which body was recently held at Trenton, N.J. The committee, in concluding its report, submitted the following resolution, which was unanimously adopted: —

Whereas there are several and conflicting uses of the term "manual training," be it hereby

Resolved that the New Jersey Council of Education defines "manual training" as "training in thought-expression by other means than gesture and verbal language, in such a carefully graded course of study as shall also provide adequate training for the judgment and the executive faculty." This training will necessarily include drawing and constructive work, but experience alone can determine by what special means this instruction may best be given.

From an educational standpoint, the definition of "manual training" formulated by the committee would appear to be indisputable; but that the definition, supported as it is by the broad pedagogic principles which underlie it, will be universally accepted as authoritative and final, is not as certain as that the definition is such as to best subserve true educational aims. At least, it is safe to say that thousands of educators and school-officers must eliminate from their minds the impression that manual training has for its object the learning of a trade or the acquisition of mechanical skill alone, ere the definition given by the committee can have free course.

Again: there are others who are unwilling to accept the *dicta* of schoolmen, and who insist upon the mere technical or industrial phase of manual training, and can see nothing beyond it. Any thing that does not centre in this is, to them, an indubitable evidence of inutility. Training of thought, of judgment, of expression, etc., as educational stimuli, do not as potent factors enter into their conception of the aim and end of manual training.

That the training of the school workshop has a reflex influence upon the traditional occupations and "studies" of the classroom, causing pupils to reflect, to compare, to be careful and exact in these also, has not thus far been taken into the estimate of the worth of manual training as generally as the facts warrant; for manual training is not that of the hand alone, but of the intellect as well.

The joint training of the mental faculties and the hands tends to dignify the labor of the latter, — the form of labor which by many is alone recognized as "work." But it does not end there: it affords at the same time opportunities for the discovery of latent inventive or mechanical genius, and, when such discovery is made, serves as a guide in the choice of employment.

One must necessarily lead an unsatisfactory and precarious existence, who, from a false estimate of the relative respectability of two or more employments, chooses that for which he has but little natural aptitude and less acquired skill. And is it not true that the popular education of the past has tended toward the making of such choices? Has it not tacitly inculcated the idea that professional employment — the law, medicine, the pulpit, or the professor's chair — is the "chief end of man" according to the creed of the schools? In numberless instances such choices have been made, with the attendant and natural result of dismal failure.

As a corrective, manual training brings to bear a species of craniology which will eventually develop a more rational creed; and this view of manual training I conceive to be entirely compatible with the definition which the committee on manual training formulated.

O. M. BRANDS.

Paterson, N.J., Jan. 7.

Color-Blindness.

A SHORT time ago I tested the color-perception of forty-two boys who had had kindergarten training. Their ages were from nine to fifteen. Not one of them made an error in matching colors. They were not asked to name them. This result suggests further investigation upon this class of pupils, not only to add one more fact to our knowledge of color-blindness, but also to determine the value of early instruction in colors.

ARTHUR STEVENS.

Jefferson, N.Y., Jan. 6.